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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/801,450	MALVAR ET AL.	
	Examiner	Art Unit	
	COLIN M. LAROSE	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-40* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10,13-17,20-25,28,29 and 31-40* is/are rejected.

7)☒ Claim(s) *11,12,18,19,26,27 and 30* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *3/15/04; 9/22/05*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 101

1. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

2. Claim 9 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter as follows. Claim 9 defines a computer-readable medium, which according to the Specification at pp. 36-37, can correspond to a data signal or carrier wave containing functional descriptive material. While functional descriptive material may be claimed as a statutory product (i.e., a "manufacture") when embodied on a tangible computer readable medium, a signal per se does not fall within any of the four statutory classes of 35 U.S.C. §101. See *In re Nuijten*, 500 F.3d 1346 (Fed. Cir. 2007).

3. The USPTO "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility" (Official Gazette notice of 22 November 2005), Annex IV, reads as follows:

> Descriptive material can be characterized as either "functional descriptive material" or "nonfunctional descriptive material." In this context, "functional descriptive material" consists of data structures and computer programs which impart functionality when employed as a computer component. (The definition of "data structure" is "a physical or logical relationship among data elements, designed to support specific data manipulation functions." The New IEEE Standard Dictionary of Electrical and Electronics Terms 308 (5th ed. 1993).) "Nonfunctional descriptive material" includes but is not limited to music, literary works and a compilation or mere arrangement of data.
>
> When functional descriptive material is recorded on some computer-readable medium it becomes structurally and functionally interrelated to the medium and will be statutory in most cases since use of technology permits the function of the descriptive material to be realized. Compare In re Lowry, 32 F.3d 1579, 1583-84, 32 USPQ2d 1031, 1035 (Fed. Cir. 1994) (claim to data structure stored on a computer readable medium that increases computer efficiency held statutory) and Warmerdam, 33 F.3d at 1360-61, 31 USPQ2d at 1759 (claim to computer having a specific data structure stored in memory held statutory product-by-process claim) with Warmerdam, 33 F.3d at 1361, 31 USPQ2d at 1760 (claim to a data structure per se held nonstatutory).
>
> In contrast, a claimed computer-readable medium encoded with a computer program is a computer element which defines structural and functional interrelationships between the computer program and the rest of the

> computer which permit the computer program's functionality to be realized, and is thus statutory. See Lowry, 32 F.3d at 1583-84, 32 USPQ2d at 1035.

4. Claims 37-40 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter as follows. Claims 37-40 define a system of modules embodying functional descriptive material. However, the claim does not define a computer-readable medium or memory and is thus non-statutory for that reason (i.e., "When functional descriptive material is recorded on some computer-readable medium it becomes structurally and functionally interrelated to the medium and will be statutory in most cases since use of technology permits the function of the descriptive material to be realized" – Guidelines Annex IV). That is, the scope of the presently claimed invention lacks physical structure and recites merely software modules. The examiner suggests amending the claim to embody the system of modules on a "computer-readable storage medium" or equivalent in order to make the claim statutory. Any amendment to the claim should be commensurate with its corresponding disclosure.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 1-9, 10, 13-16, 20-25, 28, and 37-40 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,805,217 by Lu et al. ("Lu").

Regarding claim 1, Lu discloses a method for interpolating a desired color at a current pixel in a color image, the current pixel having a current color, comprising:

computing an interpolation of the desired color at the current pixel using the desired color (column 5/55-60: interpolation of green (G) computed as $(G_{preceding} + G_{following})/2$);

computing a correction term using the current color (column 5/55-60: correction term using blue (B) calculated as $(2B_0 - B_{-2} - B_2)/2$); and

linearly combining the interpolation and the correction term to obtain a corrected interpolation of the desired color at the current pixel (column 5/55-60: $(G_{preceding} + G_{following})/2$ is linearly combined with $(2B_0 - B_{-2} - B_2)/2$ to interpolate the green color for the pixel).

Regarding claim 2, Lu discloses using neighboring pixels of the desired color in computing the interpolation (i.e., $G_{preceding}$ and $G_{following}$ are colors of neighboring pixels).

Regarding claim 3, Lu discloses using the current pixel in computing the correction term (i.e., B_0 is the current pixel).

Regarding claim 4, Lu discloses using neighboring pixels of the current color in computing the correction term (i.e., B_{-2} and B_2 are neighboring pixels).

Regarding claim 5, Lu discloses the interpolation is a bilinear interpolation technique ($(G_{preceding} + G_{following})/2$ is a bilinear technique).

Regarding claim 6, Lu discloses the correction term is a gradient correction (i.e., $2B_0 - B_{-2} - B_2$ corresponds to gradients between the center pixel and neighboring pixels).

Regarding claim 7, Lu discloses applying a gradient-correction gain to the gradient correction to determine the amount of the gradient correction linearly combined with the interpolation (i.e., the sigma gain is applied to the gradient correction).

Regarding claim 8, Lu discloses adding the interpolation and the correction term to obtain a corrected interpolation (see column 5/55-60).

Regarding claim 9, Lu discloses a computer-implemented method for interpolating a desired color at a current pixel in an image sensor, the current pixel having a first color, comprising: computing a first interpolation of the desired color at the current pixel using pixels having the desired color; computing a gradient correction using pixels having the first color; and linearly combining the first interpolation and the gradient correction to obtain a gradient-corrected interpolation of the desired color at the current pixel (see column 5/55-60).

Regarding claim 10, Lu discloses applying a gradient-correction gain to the gradient correction to affect the amount of the gradient correction that is linearly combined with the first interpolation (i.e., sigma gain).

Regarding claim 13, Lu discloses the first interpolation is a linear interpolation (i.e., $(G_{preceding} + G_{following})/2$ is a linear interpolation).

Regarding claim 14, Lu discloses the linear interpolation is a bilinear interpolation ($(G_{preceding} + G_{following})/2$ is a bilinear interpolation).

Regarding claim 15, Lu discloses the first interpolation is at least one of: (a) a bilinear interpolation; (b) a bi-cubic interpolation; (c) a Lanczos interpolation ($(G_{preceding} + G_{following})/2$ is a bilinear interpolation).

Regarding claim 16, Lu discloses: defining a region of support as a size of a pixel neighborhood whose values are considered for computation associated with any given pixel; selecting the region of support to include pixels nearest the current pixel having the first color; and using the region of support to compute the first interpolation and the gradient correction (i.e., Lu's region of support used in the interpolation is defined according to the equation at column 5/55-60).

Regarding claim 20, Lu discloses: using a first region of support to compute the first interpolation (i.e., the G values of preceding and following pixels); and using a second region of support to compute the gradient correction (i.e., the values at B_{-2} and B_2).

Regarding claim 21, Lu discloses the first region of support is different from the second region of support (i.e., the G values of preceding and following pixels correspond to pixels that are different from the pixels corresponding to the values at B_{-2} and B_2).

Regarding claim 22, Lu discloses a computer-readable medium having computer-executable instructions for performing the computer-implemented method recited in claim 9 (see column 4/47-50).

Regarding claim 23, Lu discloses a method for interpolating missing red-blue-green (RGB) data at a current pixel having a current color in a color image sensor, comprising:

using a first interpolation technique based on a missing color at the current pixel to determine a missing color estimate; calculating a gradient correction based on the current color; multiplying the gradient correction by a gradient-correction gain to obtain an adjusted gradient correction; and combining in a linear manner the missing color estimate and the adjusted

gradient correction to obtain a linearly corrected missing color estimate corresponding to at least some of the missing RGB data (see column 5/55-60).

Regarding claim 24, Lu discloses the first interpolation technique is a bilinear interpolation (($G_{preceding}$ + $G_{following}$)/2 is a bilinear interpolation).

Regarding claim 25, Lu discloses the gradient correction is a linear operator (i.e., $2B_0 - B_{-2} - B_2$ is a linear operation).

Regarding claim 28, Lu discloses a process (column 5/55-60) for linearly interpolating a missing color of a present pixel within a color image produced by a digital camera system having an image sensor, the present pixel having a first color, the process comprising:

defining a first region of support centered at the present pixel (i.e., the region encompassing the preceding and following pixels having G values corresponds to a first support region);

interpolating the missing color using an interpolation technique to obtain a first missing color estimation, the interpolation technique using pixels within the first region of support having the missing color (i.e., interpolation of green (G) computed as ($G_{preceding}$ + $G_{following}$)/2);

defining a second region of support centered at the present pixel (i.e., the region encompassing the pixels corresponding to the values at B_{-2} and B_2 corresponds to a second support region);

calculating a gradient correction using the present pixel and pixels within the second region of support having the first color (i.e., gradient correction factor computed as $2B_0 - B_{-2} - B_2$);

applying a gradient-correction gain to the gradient correction that represents a percentage of the gradient correction to be used (i.e., sigma gain); and

linearly combining the first missing color estimation and the gradient correction to obtain a gradient-corrected estimation of the missing color (i.e., $(G_{preceding} + G_{following})/2$ is linearly combined with $(2B_0 - B_{-2} - B_2)/2$ to interpolate the green color for the pixel).

Regarding claim 37, Lu discloses a gradient-corrected linear interpolation system (figure 1) for interpolating a missing color value at a given pixel in a color image, the given pixel having a current color, comprising: an interpolation module (36) that computes an interpolation of the missing color value; a correction term computation module (36) that computes a correction term for the interpolation; and a linear combination module (36) that linearly combines the interpolation and correction term to produce a corrected interpolation for the missing color value at the given pixel.

Regarding claim 38, Lu discloses the correction term computation module further comprises a region of support module that selects a size of a region of support around the given pixel centered at the given pixel (i.e., the interpolation processor 36 selects the support region according to the equation at column 5/55-60).

Regarding claim 39, Lu discloses the correction term computation module further comprises a gradient-correction selector that selects the amount of correction that will be linearly combined with the interpolation (i.e., the interpolation processor 36 selects the amount of correction (sigma) according to the equation at column 5/55-60).

Regarding claim 40, Lu discloses the correction term computation module further comprises a gradient correction module that computes a gradient correction using the given pixel and pixels in a region of support having the current color (i.e., the interpolation processor 36 computes the gradient correction factor computed as $2B_0 - B_{-2} - B_2$).

7. Claims 1-11, 13-17, 20-25, 28, 29, and 31-40 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 7,236,191 by Kalevo et al. ("Kalevo").

Regarding claim 1, Kalevo discloses a method for interpolating a desired color at a current pixel in a color image, the current pixel having a current color, comprising:

computing an interpolation of the desired color at the current pixel using the desired color (column 4/35-49: interpolation of green (AvgG) computed as (G4 + G6)/2 for the horizontal direction or (G2 + G8)/2 for the vertical direction);

computing a correction term using the current color (column 4/1-20: correction term using blue (B) or red (R) calculated as LapCHor and LapCVer and assigned to LapCorTermG at column 4/35-49); and

linearly combining the interpolation and the correction term to obtain a corrected interpolation of the desired color at the current pixel (column 4/35-49 and column 5/30-35: AvgG is linearly combined with LapCorTermG to interpolate the green color for the pixel).

Regarding claim 2, Kalevo discloses using neighboring pixels of the desired color in computing the interpolation (i.e., G2-G8 are colors of neighboring pixels—see figure 2).

Regarding claim 3, Kalevo discloses using the current pixel in computing the correction term (i.e., R5 and B5 are used).

Regarding claim 4, Kalevo discloses using neighboring pixels of the current color in computing the correction term (i.e., R1, R3, R7, R9 and B1, B3, B7, B9 are neighboring pixels).

Regarding claim 5, Kalevo discloses the interpolation is a bilinear interpolation technique (AvgG is a bilinear interpolation).

Regarding claim 6, Kalevo discloses the correction term is a gradient correction (i.e., LapCHor and LapCVer corresponds to gradients between the center pixel and neighboring pixels).

Regarding claim 7, Kalevo discloses applying a gradient-correction gain to the gradient correction to determine the amount of the gradient correction linearly combined with the interpolation (column 5/30-35, gain is applied to the gradient correction LapCorTerm).

Regarding claim 8, Kalevo discloses adding the interpolation and the correction term to obtain a corrected interpolation (see columns 4/35-49 and 5/30-35).

Regarding claim 9, Kalevo discloses a computer-implemented method for interpolating a desired color at a current pixel in an image sensor, the current pixel having a first color, comprising: computing a first interpolation of the desired color at the current pixel using pixels having the desired color; computing a gradient correction using pixels having the first color; and linearly combining the first interpolation and the gradient correction to obtain a gradient-corrected interpolation of the desired color at the current pixel (see column 4/1—column 5/35).

Regarding claim 10, Kalevo discloses applying a gradient-correction gain to the gradient correction to affect the amount of the gradient correction that is linearly combined with the first interpolation (column 5/30-35, gain is applied to the gradient correction LapCorTerm).

Regarding claim 11, Kalevo discloses selecting the gradient-correction gain such that a mean-squared error is minimized to produce an optimal gradient-correction gain (+++++).

Regarding claim 13, Kalevo discloses the first interpolation is a linear interpolation (i.e., AvgG is a linear interpolation).

Regarding claim 14, Kalevo discloses the linear interpolation is a bilinear interpolation (AvgG is a bilinear interpolation).

Regarding claim 15, Kalevo discloses the first interpolation is at least one of: (a) a bilinear interpolation; (b) a bi-cubic interpolation; (c) a Lanczos interpolation (AvgG is a bilinear interpolation).

Regarding claim 16, Kalevo discloses: defining a region of support as a size of a pixel neighborhood whose values are considered for computation associated with any given pixel; selecting the region of support to include pixels nearest the current pixel having the first color; and using the region of support to compute the first interpolation and the gradient correction (i.e., Kalevo's region of support used in the interpolation is defined according to the 5x5 region shown in figure 2).

Regarding claim 17, Kalevo's region of support is a 5.times.5 pixel region centered at the current pixel (see figure 2).

Regarding claim 20, Kalevo discloses: using a first region of support to compute the first interpolation (i.e., the G values G2-G8 within a 3x3 window); and using a second region of

support to compute the gradient correction (i.e., the B and R values at B1/R1, R3/R3, B7/R7, and B9/R9 within a 5x5 window).

Regarding claim 21, Kalevo discloses the first region of support is different from the second region of support (see explanation above for claim 20).

Regarding claim 22, Kalevo discloses a computer-readable medium having computer-executable instructions for performing the computer-implemented method recited in claim 9 (see e.g., column 2/34-48).

Regarding claim 23, Kalevo discloses a method for interpolating missing red-blue-green (RGB) data at a current pixel having a current color in a color image sensor, comprising:

using a first interpolation technique based on a missing color at the current pixel to determine a missing color estimate; calculating a gradient correction based on the current color; multiplying the gradient correction by a gradient-correction gain to obtain an adjusted gradient correction; and combining in a linear manner the missing color estimate and the adjusted gradient correction to obtain a linearly corrected missing color estimate corresponding to at least some of the missing RGB data (see column 4/1—column 5/35).

Regarding claim 24, Kalevo discloses the first interpolation technique is a bilinear interpolation (AvgG is a bilinear interpolation).

Regarding claim 25, Kalevo discloses the gradient correction is a linear operator (i.e., AvgG is a linear operation).

Regarding claim 28, Kalevo discloses a process for linearly interpolating a missing color of a present pixel within a color image produced by a digital camera system having an image sensor, the present pixel having a first color, the process comprising:

defining a first region of support centered at the present pixel (figure 2: the G values G2-G8 correspond to a 5x5 support region);

interpolating the missing color using an interpolation technique to obtain a first missing color estimation, the interpolation technique using pixels within the first region of support having the missing color (column 4/1—5/35: interpolation of green (G) computed as AvgG);

defining a second region of support centered at the present pixel (figure 2: the B and R values at B1/R1, R3/R3, B7/R7, and B9/R9 correspond to a 5x5 support region);

calculating a gradient correction using the present pixel and pixels within the second region of support having the first color (column 4/1—5/35, gradient correction factor computed as LapCorTerm);

applying a gradient-correction gain to the gradient correction that represents a percentage of the gradient correction to be used (column 5/30-35: gain value); and

linearly combining the first missing color estimation and the gradient correction to obtain a gradient-corrected estimation of the missing color (column 5/3—35: AvgG is linearly combined with LapCotrTerm to interpolate the green color for the pixel).

Regarding claim 29, Kalevo varying the gradient-correction gain based on statistics of the color image (column 5/30-35: gain is based on DiffG and DiffR statistics).

Regarding claim 31, Kalevo discloses measuring local statistics for each region in the color image; and varying the gradient-correction gain based on the local statistics (column 5/30-35: gain is based on local statistics).

Regarding claim 32, Kalevo discloses computing the gradient-correction gain based on the missing color (column 5/30-35: gain is based on green color values).

Regarding claim 33, Kalevo discloses the missing color is green but does not expressly teach that the gradient-correction gain is a value of 1/2. However, those skilled in the art would have recognized that the value of Kalevo's gain is based on an equation that may produce a value of 1/2. In those instances, it would have been obvious for the gain to be set to the value of 1/2.

Regarding claims 34 and 35, Kalevo discloses the missing color is red or blue (columns 6/45—8/45: similar interpolation and gradient correction terms are linearly combined for missing red and blue colors). Kalevo does not expressly teach that the gradient-correction gains are value of 5/8 or 3/4 as claimed. However, those skilled in the art would have recognized that the value of Kalevo's gains are based on equations that may produce values of 5/8 or 3/4. In those instances, it would have been obvious for the gain to be set to the value of 5/8 or 3/4.

Regarding claim 36, Kalevo discloses the first and second regions of support are a 5x5 matrix of pixels (see figure 2).

Regarding claim 37, Kalevo discloses a gradient-corrected linear interpolation system (column 2/20-33: apparatus; column 2/34-48: program) for interpolating a missing color value at a given pixel in a color image, the given pixel having a current color, comprising: an interpolation module that computes an interpolation of the missing color value; a correction term

computation module that computes a correction term for the interpolation; and a linear combination module that linearly combines the interpolation and correction term to produce a corrected interpolation for the missing color value at the given pixel.

Regarding claim 38, Kalevo discloses the correction term computation module further comprises a region of support module that selects a size of a region of support around the given pixel centered at the given pixel (figure 2: 5x5 region of support selected).

Regarding claim 39, Kalevo discloses the correction term computation module further comprises a gradient-correction selector that selects the amount of correction that will be linearly combined with the interpolation (column 5/30-35: gain selected).

Regarding claim 40, Kalevo discloses the correction term computation module further comprises a gradient correction module that computes a gradient correction using the given pixel and pixels in a region of support having the current color (column 4/1—5/35, gradient correction factor computed as LapCorTerm).

Allowable Subject Matter

8. Claims 11, 12, 18, 19, 26, 27, and 30 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Related Prior Art

9. Additional prior art document(s) considered by the Examiner but not relied upon are listed on the attached "Notice of References Cited."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colin M. LaRose whose telephone number is (571) 272-7423. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Werner, can be reached on (571) 272-7401. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000. Any inquiry of a general nature or relating to the status of this application or proceeding can also be directed to the TC 2600 Customer Service Office whose telephone number is (571) 272-2600.

/Colin M. LaRose/
Colin M. LaRose
Group Art Unit 2624
22 March 2008